

HTAP in GIOVANNI

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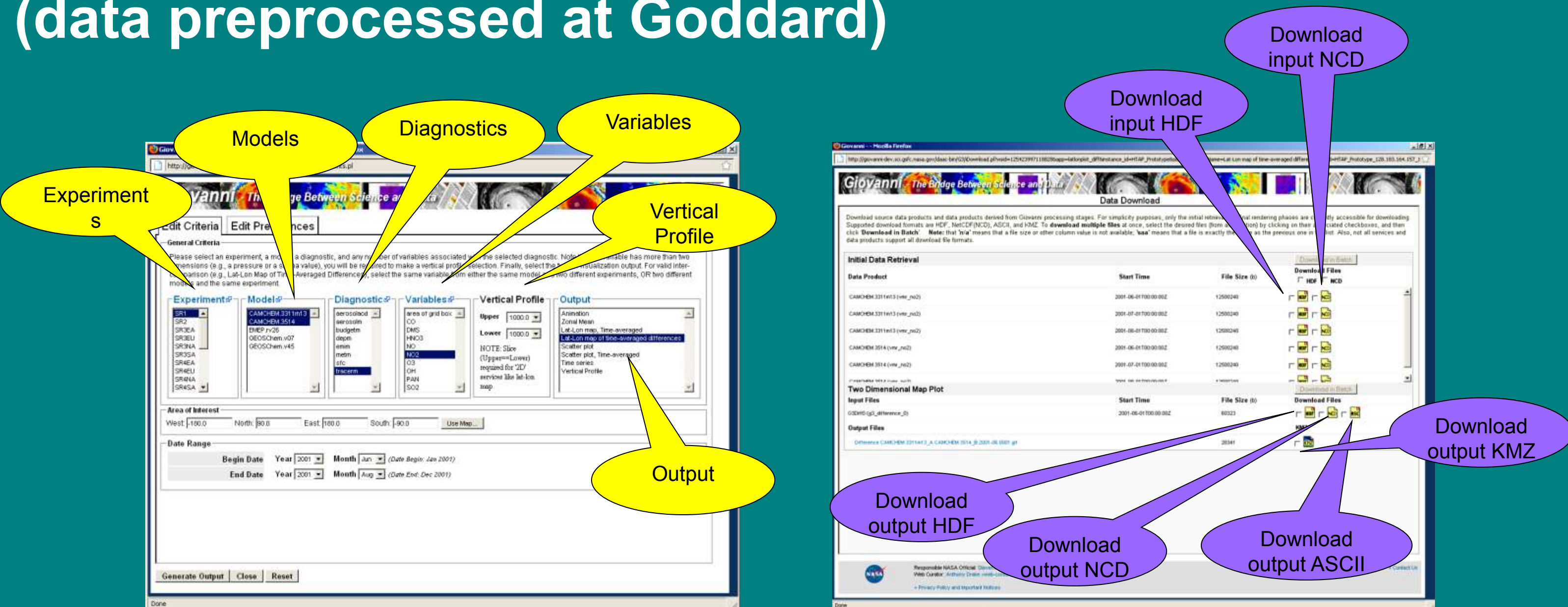
Introduction

Air pollutants, such as aerosols and various trace gases, are transported on a hemispheric or global scale. The Task Force on Hemispheric Transport of Air Pollution (HTAP) is studying the intercontinental transport of air pollution in the Northern Hemisphere by conducting a series of multi-model evaluations and inter-comparison experiments to: produce estimates of intercontinental source-receptor relationships; improve the understanding of the variability and uncertainty in current model estimates; assess potential future changes in source receptor relationships; and guide future model developments to decrease uncertainties in source-receptor relationships.

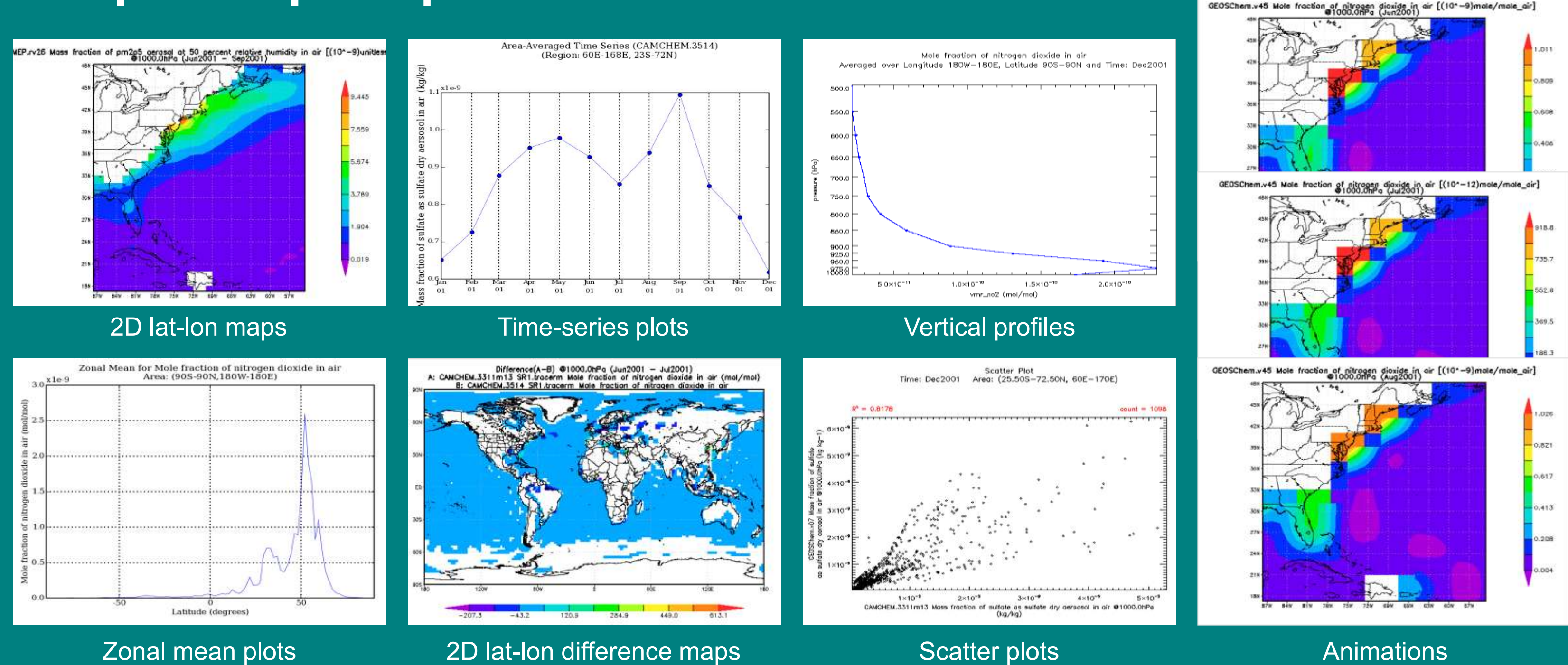
The Giovanni HTAP Prototype GUI provides the flexibility to display multiple experiments, models, diagnostics, and variables simultaneously on an array of visualizations. Image choices include: latitude-longitude maps (time-averaged), latitude-longitude maps of time-averaged differences, animations, vertical profiles, and time-series, scatter, and zonal mean plots. Users have the ability to choose the upper and lower limits of the vertical layer to display, along with the start and end time (for 2001 monthly data). The data is downloaded from the HTAP server, stored locally, and is then pre-processed to convert the different vertical levels for each model to uniform pressure levels. This tool is web-based, so all of the visualization, analysis, and data extraction can be done online using a regular web browser, without the need to remotely log on to HTAP servers or download data and software to a local machine.

Recently, Giovanni has implemented a demonstration site in which HTAP model data are received from the Juelich HTAP WCS server (i.e., not locally stored). Currently, the Giovanni HTAP WCS demo presents two models for viewing: CAMCHEM3311m13 (SR1 and SR2) and ECHAM5_HAMMOZ (SR1 and SR6EU). Ozone, sulfur dioxide, and nitrogen dioxide variables are available for these models and experiments. A large majority of HTAP data residing on the Juelich server are available on sigma levels. The data are not pre-processed to uniform pressure levels, making it difficult for model inter-comparison on specific vertical layers. The CAMCHEM3311m13 model data are on pressure levels. ECHAM5_HAMMOZ model data are on sigma levels. Thus, the experiments for one model may be compared (CAMCHEM3311m13 SR1 versus SR2 and ECHAM5_HAMMOZ SR1 versus SR6EU), but the models themselves cannot.

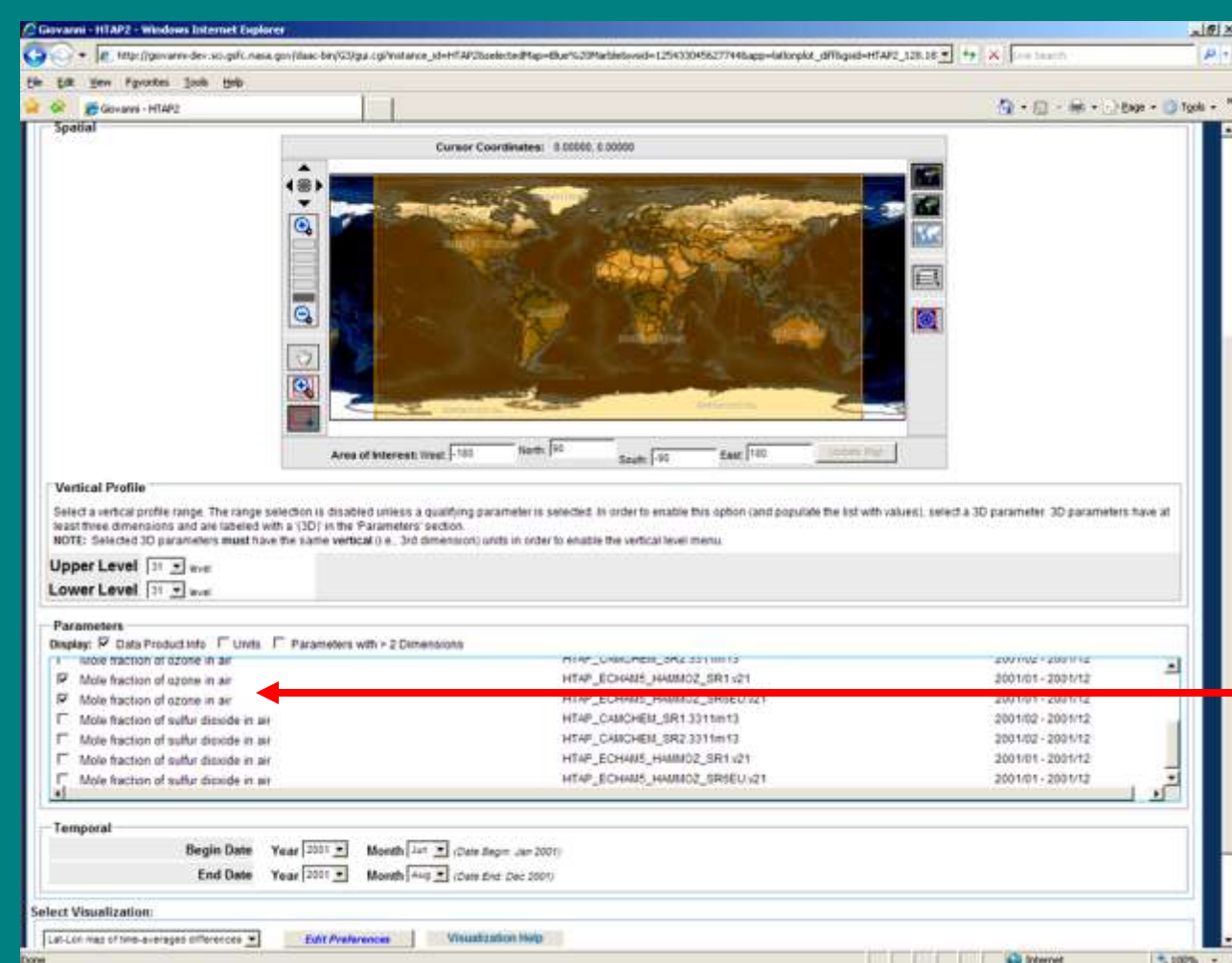
GIOVANNI HTAP Prototype (data preprocessed at Goddard)



Sample Output Options



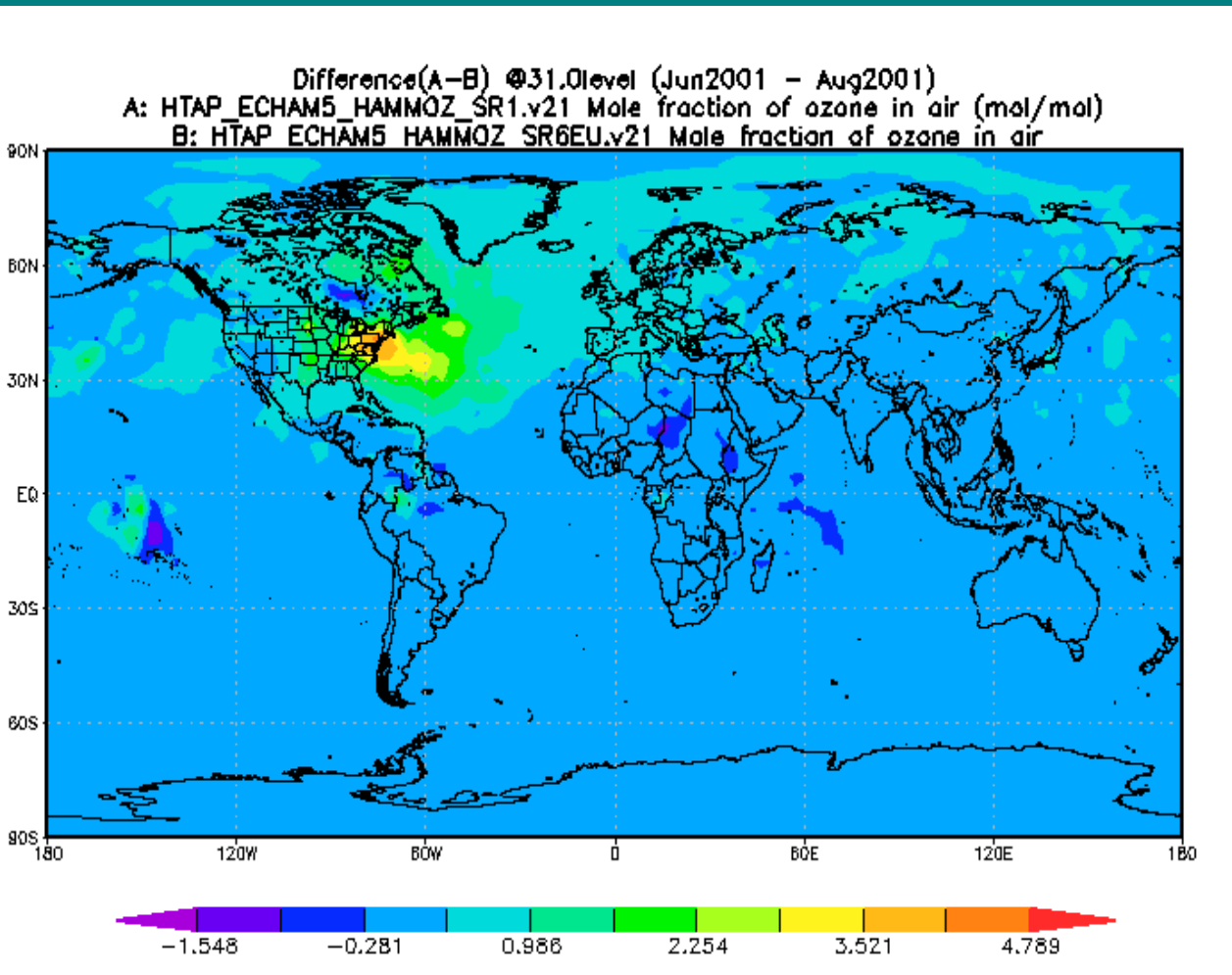
GIOVANNI HTAP (direct access to the archive at Juelich via WCS)



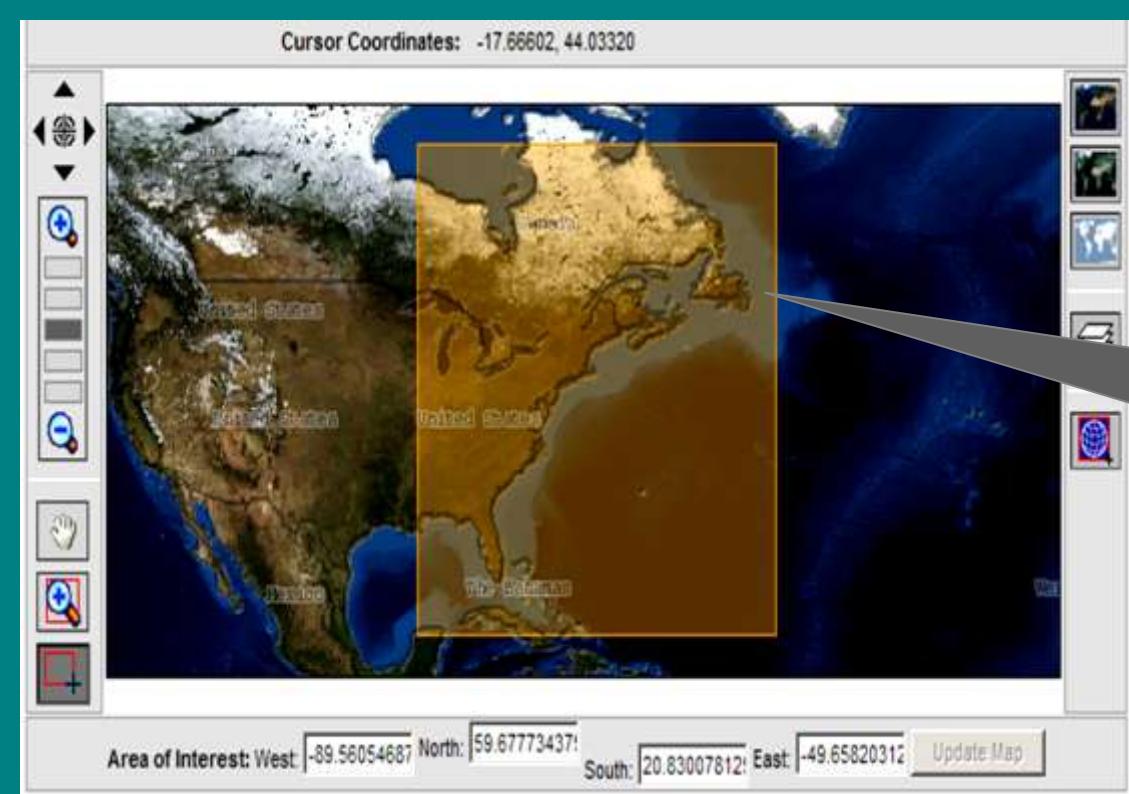
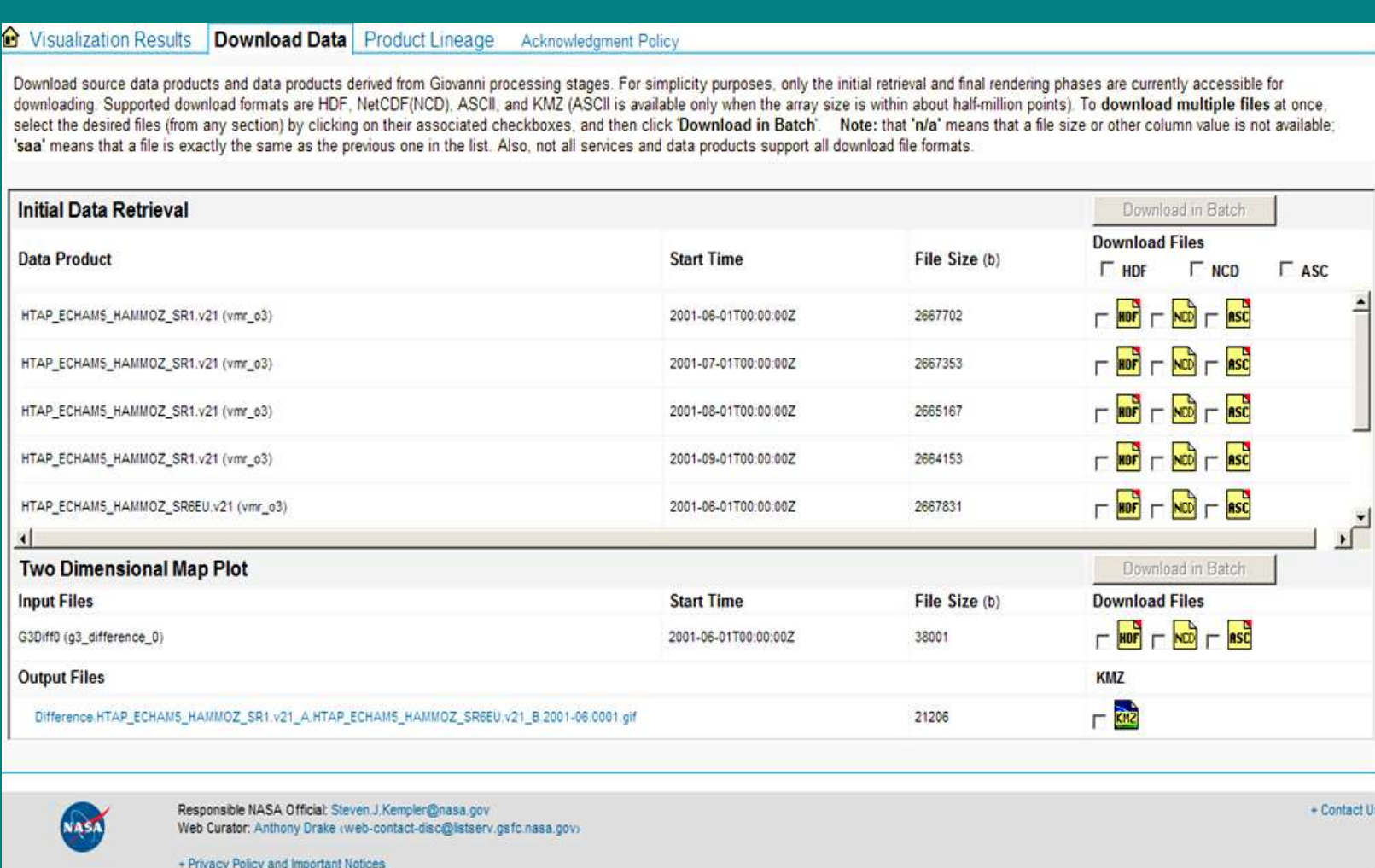
Giovanni HTAP WCS currently contains O3, SO2, and NO2 data for CAMCHEM3311m13's SR1 & SR2 experiments and ECHAM5_HAMMOZ's SR1 & SR6EU experiments.

In this example, ozone is examined for ECHAM5_HAMMOZ's SR1 & SR6EU experiments.

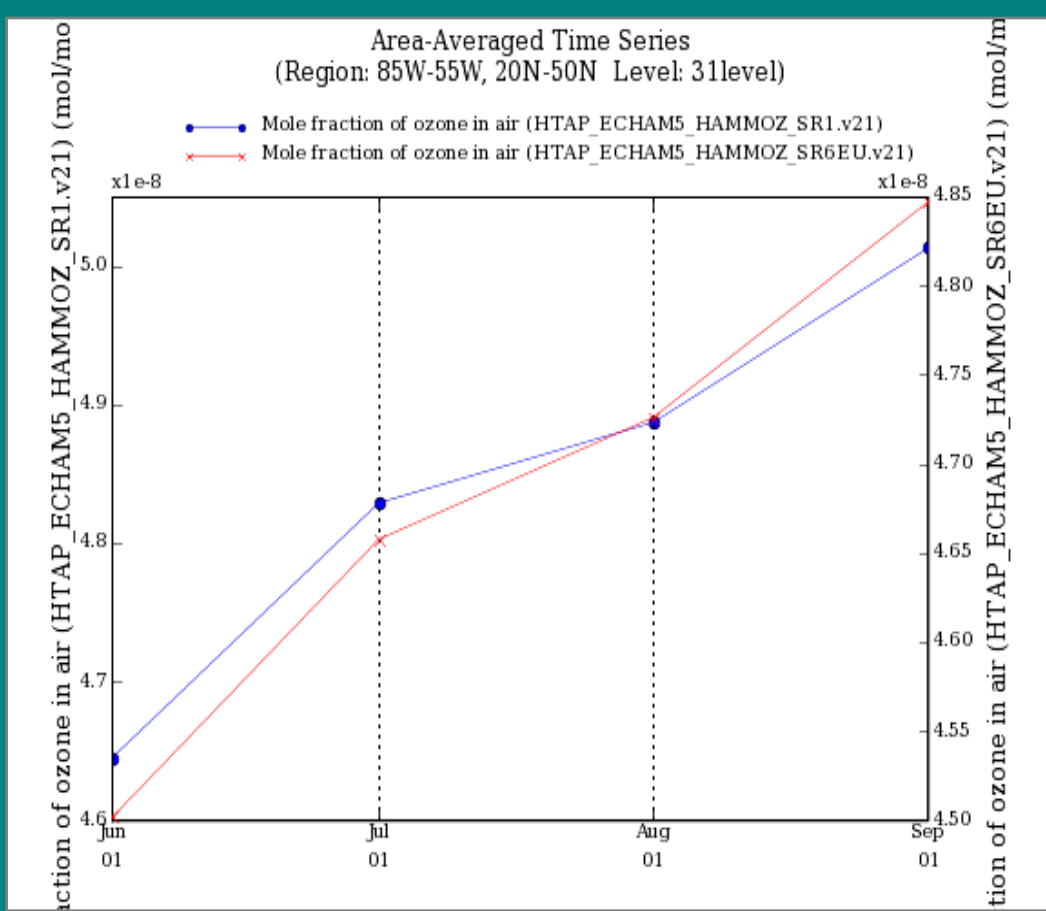
The difference between SR1 and SR6EU indicates a reduction in O3 receptor emissions along the US eastern seaboard.



As is the case for Giovanni HTAP Prototype, the WCS version also allows users to download the initial and final data in HDF, NetCDF, and ASCII format. The final image may be downloaded as a KMZ file.

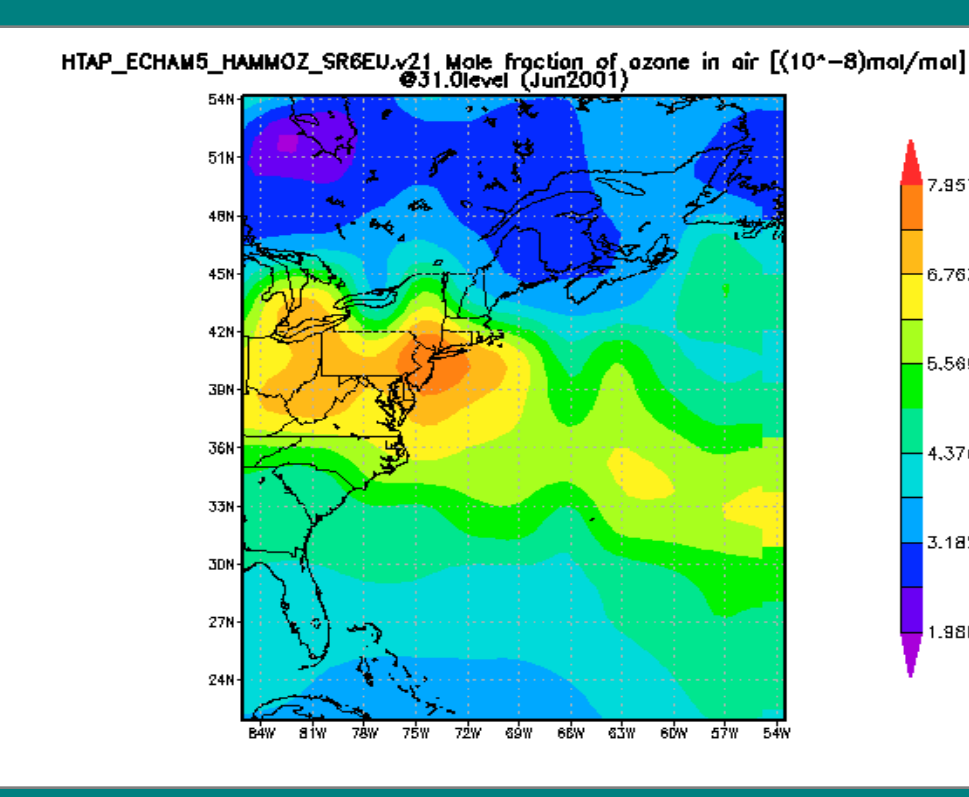


Zoom into target area and create time-series and lat-lon maps to visualize change.

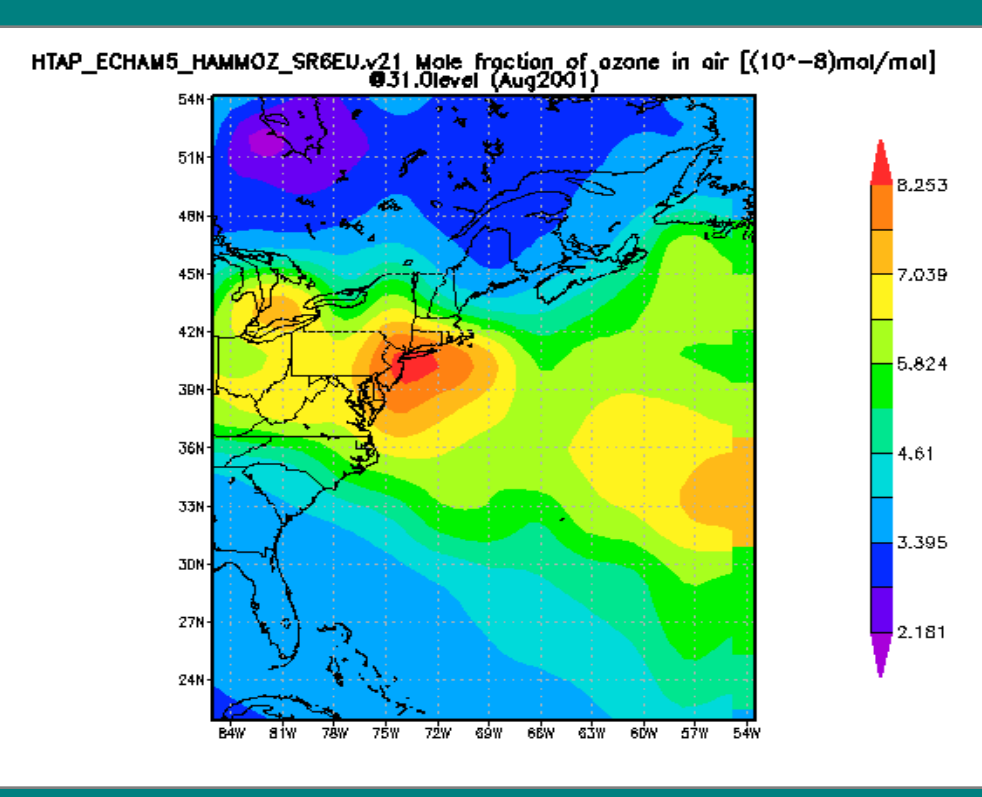
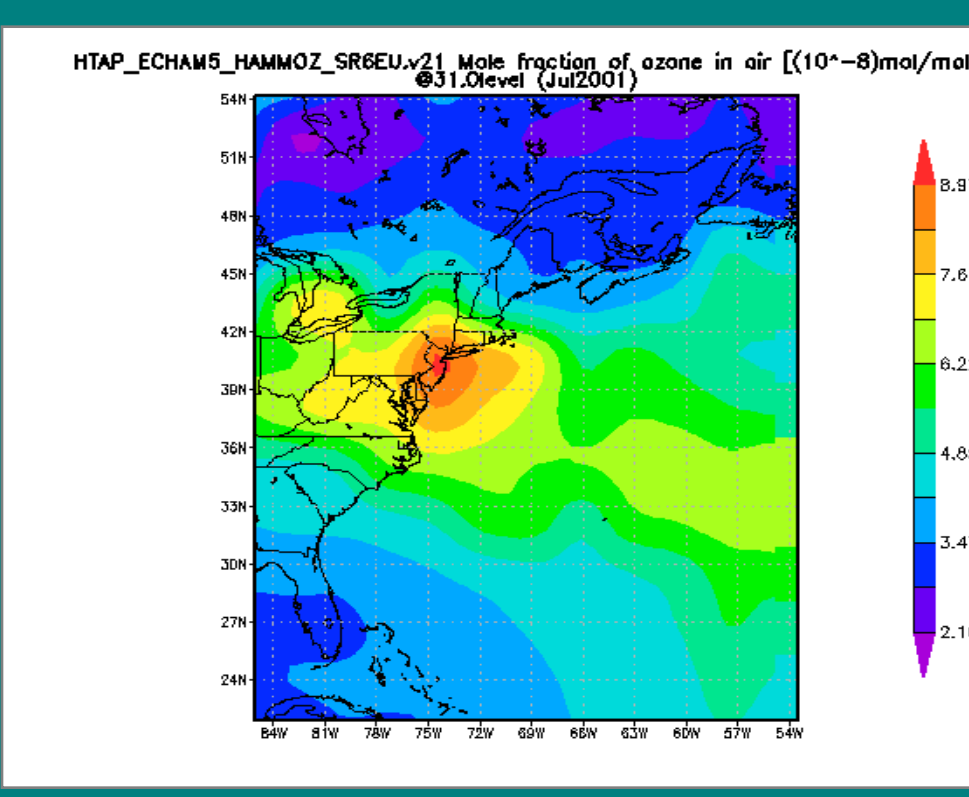


This time-series overlay of SR1 vs SR6EU highlights the slight reduction of ozone over the target area through June and July and the domination of local summertime emissions by August.

SR1 experiment uses best estimate emissions for 2001.



SR6EU experiment reduces anthropogenic emissions by 20% for Europe.



Animations are included in Giovanni HTAP WCS. In this case, local ozone emissions from the northeast portion of the US are captured.

LIMITATIONS OF RETRIEVING THE DATA VIA WCS

- The data are not pre-processed to uniform pressure levels making it difficult for model inter-comparison.
- Retrieval time is on the order of 2 minutes (for a year request) as opposed to a few seconds, when stored locally.
- Models define time as "days since X", where X varies between models. Additionally, time is valid for day Y of the month, where Y also may vary by model.
- Quality control is needed for models which have fields that are populated with zeroes or that do not specify a missing value.

Time Discrepancies Between Models

Model	Time displayed in Panopoly	value in NetCDF file	DescribeCoverage begin	DescribeCoverage end	time defined as days since...
CAMCHEM.3311m13	error "time empty after filtering"	error "time empty after filtering"	2001-02-01T00:00:00Z	2002-01-01T00:00:00Z	6/1/2000
CAMCHEM.3514	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	6/1/2000
CHASER-v03	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	1/1/2001
EMEP-rv26	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
FRSGCUCI-v01	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
GEMQA-EC	returns 2001-01-01 - 2001-01-31	15	2001-01-01T00:00:00Z	2001-11-27T00:00:00Z	1/1/2001
GEOSChem-v07	returns 2001-01-01 12:00:00 AM	0	2001-01-01T00:00:00Z	2001-12-01T00:00:00Z	1/1/2001
GEOSChem-v45	returns 2001-01-01 12:00:00 AM	0	2001-01-01T00:00:00Z	2001-12-01T00:00:00Z	1/1/2001
GISS-PUCINI-modelA	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
GISS-PUCINI-modelE	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
GISS-PUCINI-modelEaer	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	1/1/2001
GMI-v02a	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
GMI-v02f	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	1/1/2001
GOCART-v4p1	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
GOCART-v4p2	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
INCA-v2MS	(not working for WCS)	(not working for WCS)	(not working for WCS)	(not working for WCS)	1/1/2001
INCA-vSSZ	(not working for WCS)	(not working for WCS)	(not working for WCS)	(not working for WCS)	1/1/2001
MOZARTGFDL-v2	returns 2001-01-01 - 2001-02-01	15.5	2001-01-16T12:00:00Z	2001-12-16T12:00:00Z	1/1/2001
MOZECH-v16	returns 2001-01-15 12:00:00 PM	14.5	2001-01-15T12:00:00Z	2001-12-15T12:00:00Z	1/1/2001
MSCE-POP-v2p2	returns 2001-01-01 - 2001-02-01	15	2001-01-01T00:00:00Z	2001-12-27T00:00:00Z	1/1/2001
ULAQ-v02	returns 2000-12-26 00:00	360	2000-01-31T00:00:00Z	2000-12-26T00:00:00Z	1/1/2000
GFDL-AM3	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	1/1/2001
GLEMOS-v1p0	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	(product not available via WCS)	1/1/2001
ECHAM5	returns 2001-01-16	15	2001-01-16T00:00:00Z	2001-12-16T00:00:00Z	1/1/2001

Vertical Layer Discrepancies Between Models

Model Name	Vertical layer/levels	Reference Pressure (Pa)	Lev Formula	Lev_Bnds Formula
CAMCHEM-3311m13	pressure	100000	N/A	N/A
CAMCHEM-3514	pressure	100000	N/A	N/A
CHASER-v03	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
ECHAM5-HAMMOZ-v21	sigma	1	$mlev=hyam+hybm*aps$	$ilev=hyai+hybi*aps$
ECHMERIT	sigma	N/A	$mlev=hyam+hybm*aps$	$ilev=hyai+hybi*aps$
ECHMERIT-v1	sigma	N/A	$mlev=hyam+hybm*aps$	$ilev=hyai+hybi*aps$
EMEP-GLOB	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
EMEP-GLOB-rv3	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
EMEP-rv26	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
FRSGCUCI-v01	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GEMQA-EC	sigma	80000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GEMQA-v1p0	sigma	1:80000	$p(n,k,j,i)=ap(k)+b(k)*ps(n,j,i)$	N/A
GEOSChem-v07	sigma	1:80000	$p(n,k,j,i)=ap(k)+b(k)*ps(n,j,i)$	N/A
GEOSChem-v45	sigma	N/A	$p(n,k,j,i)=a(k)+b(k)*ps(n,j,i)$	N/A
GFDL-AM3	sigma	101325	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GISS-PUCINI-modelA	sigma	98400	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GISS-PUCINI-modelE	sigma	98400	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GISS-PUCINI-modelEaer	sigma	98400	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GLEMOS-v1.0	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GMI-v02a	sigma	101325	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GMI-v02f	sigma	101325	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
GOCART-v4p1	sigma	N/A	N/A	N/A
GOCART-v4p2	sigma	N/A	N/A	N/A
GRAHM-1.1	sigma	1000	$p(n,k,j,i)=ptop+lev(k)*(ps(n,j,i)-ptop)$	$p(n,k,j,i)=ptop+lev_bnds(k)*(ps(n,j,i)-ptop)$
HADGEM2-A-v01	hybrid height	N/A	$z(k,j,i)=az(k)+bz(k)*orog(j,i)$	$z(k,j,i)=az(k)+bz(k)*orog(j,i)$
IFS-CY32R3	sigma	N/A	N/A	N/A
INCA-v2MS	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
INCA-vSSZ	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
LLNL-IMPACT-T5a	sigma	1000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
MOZARTGFDL-v2	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
MOZARTGFDL-v4	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
MOZECH-v16	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
MOZECH-v16a	sigma	N/A	N/A	N/A
MSCE-HM-v4.5	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
MSCE-POP-v2.2	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
OsloCTM2	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
SPRINTARS-v356	sigma	N/A	N/A	N/A
STOC-HadAM3-v01	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
STOC-HadAM3-v02	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$
STOCHEM-v02	hybrid height	N/A	$z(k,j,i)=a(k)+b(k)*orog(j,i)$	$z(k,j,i)=a(k)+b(k)*orog(j,i)$
TM5-JRC-cy2-ipc-v1	sigma	1	N/A	N/A
TM5-JRC-cy2-ipc-v1-glb3x2	sigma	N/A	N/A	N/A
TM5-JRC-cy2-ipc-v1-glb6x4	sigma	N/A	N/A	N/A
ULAQ-v02	sigma	100000	N/A	N/A
UM-CAM-v01	sigma	100000	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$	$p(n,k,j,i)=a(k)*p0+b(k)*ps(n,j,i)$

The above spreadsheets highlight both the time and vertical level discrepancies that exist between the various models participating in the HTAP project. They have been shared with the modeling community on the ESIP wiki page (http://wiki.esipfed.org/index.php/WCS_Access_to_netCDF_Files). Resolving the differences between all models, in order to potentially create a uniform dataset both in vertical space and with time definition, is ideal for users. This would greatly enhance the capabilities of the Juelich HTAP WCS service. In conjunction with Giovanni, multiple-model and multiple-experiment data may then be visualized and compared almost instantaneously.